

ADDRESS

*Delivered by the President, Captain W. de W. Abney, C.B., R.E.,
D.C.L., F.R.S., on presenting the Gold Medal to Professor
S. W. Burnham.*

THE Gold Medal of the Royal Astronomical Society has been awarded by the Council to Mr. S. W. Burnham for his discovery and measurement of double stars; and following the custom of the Society, it is the duty of the President to lay before it the grounds on which the award has been made.

I can scarcely hope to do justice to the labours entailed in the extensive researches made by Mr. Burnham, and to his discoveries. I believe I am correct in stating that Mr. Burnham's first astronomical communication was made to the *English Mechanic*. It is, however, with his star catalogues and other later communications to which your attention must be drawn. The catalogues of double stars which he has given us amount to no fewer than nineteen containing 1,274 new double stars.

Burnham's first catalogue of new double stars, published in 1873, consisted of 81 pairs, which were discovered with a 6-inch Alvan Clark refractor at Chicago, and occupied his time from 1870 to 1872. The distances of the doubles in this, as in several of his first catalogues, were estimations and not exact measurements, his telescope not being furnished with a micrometer. It may here be incidentally remarked that during the discovery of some of these pairs he was in communication with Dembowski, who measured many of them, whilst others were measured by our Fellow, Mr. Knott, and appear in his catalogue. The measures by Dembowski were not published till after this observer's death, and were, comparatively speaking, recently (1888) printed by the Reale Accademia dei Lincei at Rome. The first catalogue contains several pairs which are very difficult to see with a 6-inch, even when they are known to be doubles. For instance—

Number in Catalogue.	Magnitudes.	Distances.
4	7 and $7\frac{1}{2}$	0.5
13	8 „ 12	1.0
63	6 „ 12	0.7

Burnham's second catalogue contained twenty-five new double stars, and was like the first published by this Society in its *Monthly Notices* and in the same year, viz., 1873. The 6-inch was still his instrument, and the class of star is about the same, as will be seen from the following examples:—

Number in Catalogue.	Magnitudes.	Distances.
89	9 and 9	0 ^{''} 6
96	6 „ 14	2 ^{''} 5
104	7 „ 12	2 ^{''} 5

His third catalogue contained seventy-six new doubles, and was also published in 1873. In this Burnham began to impose restrictions on his observations, rejecting distances exceeding 5^{''} and faint pairs below the ninth magnitude when not connected with a brighter star. He thus early appears to have grasped the true idea of weeding out, instead of cataloguing, useless or uninteresting pairs. The four following stars are from this catalogue:—

Number in Catalogue.	Magnitudes.	Distances.
120 ν Scorpii	4 and 8	0 ^{''} 3
138	7 $\frac{1}{2}$ „ 10	1 ^{''} 0
141	7 $\frac{1}{2}$ „ 8 $\frac{1}{2}$	0 ^{''} 4
151 β Delphini	3 $\frac{1}{2}$ „ 5	0 ^{''} 7

This catalogue is important, as containing a class of double star peculiar to Burnham's catalogues. I refer to pairs where the principal star is a naked-eye star, and the companion close and faint.

In the pair ν Scorpii, the principal star is one of the 4th magnitude and the companion of the 8th magnitude, at a distance of less than half a second. The discovery of this pair is a remarkable feat with a 6-inch, and the more so as another companion to ν Scorpii had been measured by many observers before, and the chief component must have been well scrutinised. Burnham says, "I examined it several times under the most favourable circumstances, but could not get rid of an apparent elongation of the principal star in a direction nearly north and south. I requested Professor C. A. Young to examine it with the splendid 9 $\frac{1}{4}$ -inch Clark refractor of the Dartmouth College Observatory. He examined it several times, and at last when the air was very steady he was rather inclined to think it double, although he could not even notch it." This star was early known as a wide pair, and Jacob at Madras in 1847 found the companion was also double. The close pair was in 1874 measured with the 26-inch Washington refractor, and by Dembowski.

From what has been said, it must be evident that Burnham

has a remarkable acuteness of vision, and an eye wonderfully free from defects, such as astigmatism, which would render observations such as these impracticable.

The fourth catalogue was published in the *Monthly Notices*, June 1874. The fifth catalogue has 71 more new pairs, and brings out a peculiar characteristic of your medallist. If a star disc deviated an almost infinitesimal quantity from the circular, his eye detected it at once. In 1874, at Washington, on the night of August 11, he scanned some of his old discoveries, with the result that he made an addition of 14 new pairs to his list. I give one instance. No. 291 in the catalogue had on some occasion offended his critical eye when looking at it through the 6-inch, so he turned the 26-inch on it and found it consisted of two $8\frac{1}{2}$ -magnitude stars separated by a distance of only $0.2''$. Turning, by chance, the telescope on to 34 *Pegasi* its mystery also disappeared, for a faint companion $2''$ south was discovered.

In 1870, when your medallist began his work, very little was being done in discovering new doubles. Most observers were contented with the catalogues of the Struves and Herschel, and, so far as I can gather, he had no intention to add largely to these catalogues. His acute eye, however, rendered it impossible for him to stop. His small, though very perfect, instrument was the means of breaking through that resolution, if he had formed one. As already mentioned, Mr. Burnham has added a new class of double stars—viz. naked-eye stars with faint companions. The more difficult of these were discovered with the 36-inch Lick refractor, and have already become interesting. Out of the 1,274 new double stars which he has discovered, 197 are naked-eye stars, not previously known to be double. Of the 1,274 no fewer than 120 have been proved to be physically connected by later measures. He has found new components to 113 old pairs, as follows:—

W. Struve (Mensuræ Micrometricæ) ...	...	47
O. Struve (Pulkowa Catalogue) ...	...	14
W. Herschel ...	...	14
J. Herschel ...	...	22
South ...	...	9
South and Herschel ...	...	7

When Mr. Burnham had the use of the $15\frac{1}{2}$ -inch refractor of the Dearborn Observatory, his catalogue still showed that the maximum dividing power was what he sought, and a star from his eleventh catalogue will exemplify this. In this catalogue was β *Scorpii* of the second magnitude, with a companion of the tenth magnitude, distant only $0.8''$. Even *he* considered it a very difficult pair, and, up to that time, far beyond any close pair discovered, in the inequality of its components. No second-class instrument, however large, would show its duplicity.

In the same catalogue are

	Magnitudes.	Distances.
η Cygni	4.5 and 13	7".2
52 Hydræ	5.0 „ 11	4.0
54 Herculis	5 „ 12.5	2.6

When the great 36-inch telescope was placed at his command, he determined to still further restrict the class of star to be measured, and in selecting stars for his working catalogue, he gave the preference to such as could not or would not be observed elsewhere, leaving the easier systems to others. Speaking generally, I am informed that the most difficult to observe are the most interesting; and but for the care he bestowed on the most difficult of the old systems, as well as those of his own discovery, a serious gap would have occurred in the measures.

An idea of the recent catalogues may be derived from an analysis of his eighteenth, which contains the numbers β 1225 to β 1266, that is, 42 pairs.

	Distances.	Pairs.
Under	1"	15
Between	1 and 2	13
„	2 „ 3	7
Above	3	7

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As specimens may be cited

Numbers.	Distances.	Magnitudes.
1226	0".40	8.5 and 10.5
1240	0.15	5.6 „ 6.0
1241	0.53	5.9 „ 10.0

The faintness of the companions and the small distances of the recent Burnham pairs indicate interesting researches for the possessor of the most powerful telescopes.

In all, your medallist, as before said, has published nineteen catalogues, containing 1,274 pairs, and I believe I am correct in saying that still one more catalogue is in the press, for I learn that the proof sheets of some 250 pages have left his hands for publication. These, it may be presumed, contain the complete catalogue of all the stars which your medallist has discovered.

Of the 1,274 stars already published,

123 pairs are under	0".5	apart
230 „ between	0.5 and 1	„
370 „ „	1 „ 2	„
168 „ „	2 „ 3	„
178 „ „	3 „ 6	„
205 „ over	6	„

Thus, of all known pairs whose distance is under 1'', Mr. Burnham has added more than one half.

We must also note that, besides the measures of his new stars, we are indebted to him for many thousands of measures of previously known doubles.

Not only is Mr. Burnham an original observer, but he is a critic as well. He criticised the catalogue of Sir J. Herschel in a paper in the *Monthly Notices* in 1873.

Nor did the Bedford Catalogue escape his searching scrutiny. A paper in 1880 June in the *Monthly Notices* dealt with it somewhat severely. But all his criticisms have had the object of correcting and pointing out errors. His paper on the Trapezium of *Orion* is an example of this. He shows that the minute stars which were said to lie within it and to be visible with small telescopes are, to say the least, mythical. It has only been with the 36-inch Lick telescope that any minute stars have been found, and these would be invisible in any telescope less than a 30-inch.

Not less excellent work has been carried out by your medallist in calculating the orbits of binaries; and, as an example of the original way in which he sets to work, one has only to refer to his paper in the *Monthly Notices* of April 1891 on the Orbit of the Companion of *Sirius*. It may be mentioned that he was the last to obtain measures of the companion of *Sirius* in 1890. In 1891 he failed to detect it with the 36-inch Lick telescope. With these last observations before him, he recomputed the orbit, and found a period for it shorter than those of Gore or Howard, his period being 53 years, whilst theirs were 58.47 and 57.02 respectively. Should this orbit be correct, the companion should be again visible this year.

Of double stars discovered by Burnham which have short periods, the following are some of the most remarkable:—

	Period.	Period determined by
κ Pegasi β 989	11.37	Burnham
β 883	16.35	Glaserapp
85 Pegasi = β 733	17.48	"
β Delphini = β 151	22.97	"
9 Argus = β 101	23.3	Burnham
β 416	24.7	"
20 Persei = β 524	27.7	"
β 612	30.0	Glaserapp

It appears that there are only two other binaries whose known periods are less than 25 years. I may interpolate here a word as to a second most valuable paper on invisible double stars, in the same number of the *Monthly Notices* in which his paper on *Sirius* appears, as it indicates well his critical capabilities. In it he treats of the irregularities in the measures of certain

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double stars. These irregularities have been ascribed to the presence of a dark body in the system, and in some suggestive diagrams Mr. Burnham indicates his opinions on the subject.

It may here be noted that Burnham, in his astronomical career, has used a variety of telescopes—the 6-inch his first, a 9·4-inch at Dartmouth, the 12-inch Lick, the 15½-inch Washburn, the 18½-inch Chicago, the 26-inch Washington, the 36-inch Lick. With him, increase of aperture available meant a further refinement in his researches, and a further power for interesting work.

The catalogues of the double stars and of orbits calculated by Burnham are a formidable work to have been accomplished by any one man; but when it is remembered that this is the more serious phase of his labours, and does not include much of what one might almost characterise as a lighter character which he has contributed to astronomy, it seems almost impossible to realise that it lay within the capacity of any one individual. The *English Mechanic*, the *Monthly Notices and Memoirs of the R.A.S.*, the *Astronomische Nachrichten*, the *American Journal of Science, Astronomy and Astro-Physics, Knowledge*, the *Sidereal Messenger*, the *Observatory*, and various other papers have been enriched by his contributions. The line of work that he laid himself out to accomplish he has successfully carried through. It is not of that showy or dramatic order which attracts universal attention, or gives occasion for newspaper paragraphs. It is, however, as arduous as it is unpretending; and when more than twenty years have been devoted to it, and when the success which has attended it has been so remarkable, it does honour to the Society to recognise the high estimation in which it holds this work by awarding to its author the greatest distinction it can confer.

Mr. Burnham is an amateur in the true sense of the word. Born about 1840, as far as I can learn, he adopted the vocation of stenographer, and it was not till he had chosen his profession that his mind was fortunately directed to the study of astronomy. What his first toy telescope may have been I know not; but from the time when he secured his 6-inch Clark, he made the progress in the direction that he had determined to follow. By day he followed his regular calling, whilst by night he studied the heavens till (as an article in *The Century* informs us) “daylight drove him to bed.” In 1874 he became a Fellow of this Society, being nominated by his friend the late Rev. T. W. Webb, an astronomer to whose well-known book, apparently, Burnham was indebted for the turn which his astronomical labours were to take. In 1876 Burnham was appointed Director of the Chicago Observatory, a post which he held for a short time, though he subsequently had the use of the 18½-inch telescope at that observatory. In 1879, when the trustees of the Lick Observatory had chosen Mount Hamilton as the site on which to build their observatory, he was selected, on the recommendation of Professor Newcomb, to report on the

atmospheric and other conditions of that locality, and subsequently observed the Transit of *Mercury* from the same spot in conjunction with Professor Holden. This connection with Mount Hamilton was not destined to cease, for he was appointed to a post in the Lick Observatory, where he turned the magnificent telescope of that institution to good account in his researches. Lately he retired from the position occupied there and resumed his work at Chicago, and now holds the appointment of Professor of Practical Astronomy at that university. It is to be hoped that he will be only temporarily absent from an established observatory; for, if rumour is to be believed, he is to be Astronomer to the Yerkes Observatory, where the great 40-inch telescope is to be erected. If this be so, the choice made by the trustees is an honour to him and to themselves.

I think, gentlemen, I have said enough to convince you that the medal has been worthily bestowed and well earned, and in handing it to our honoured foreign secretary, Dr. Huggins, to transmit to him, I would ask him at the same time to convey a message from the Royal Astronomical Society "in Annual Meeting assembled," wishing Mr. Burnham health and strength to continue his contributions to astronomical science, and expressing their gratitude to him for what he has done for it in the past.

The meeting then proceeded to the election of the Officer and Council for the ensuing year, when the following Fellows were elected :—

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